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NASA Procedural Requirements

COMPLIANCE IS MANDATORY**NPR 8705.2A**Effective Date: February 07,
2005Expiration Date: February 07,
2010[Printable Format \(PDF\)](#)

Subject: Human-Rating Requirements for Space Systems**Responsible Office: Office of Safety and Mission Assurance**[| TOC](#) | [Preface](#) | [Chapter1](#) | [Chapter2](#) | [Chapter3](#) | [AppendixA](#) | [AppendixB](#) | [AppendixC](#) | [ALL](#) |

Chapter 1. Institutional and Programmatic Requirements

1.1 Roles and Responsibilities

Figure 1 provides a summary of roles and responsibilities for human-rating certification.

Figure 1. Summary of Roles and Responsibilities

(Note: Chief Health and Medical Officer serves as the Independent Technical Authority for all health and medical technical requirements, standards, and matters.)

Due Date When Using Sole Source Acquisition Approach Where Procurement is At or Shortly After Acquisition Strategy Meeting	Due Date When Using Phased Acquisition Approach Where Procurement is After SRR	<p>Key: P = Primary Responsibility C = Concur R = Review SRR = System Requirements Review PDR = Preliminary Design Review CDR = Critical Design Review FRR = Flight Readiness Review</p> <p>Tasks</p>	Chief Safety and Mission Assurance Officer	Chief Engineer (Independent Technical Authority)	Chief Health and Medical Officer (Independent Technical Authority)	Associate Administrator for Exploration Systems	Associate Administrator for Space Operations	Program Manager	Human-Rating Independent Review Team
		Provide leadership, policy direction, assessment, and coordination of the technical requirements and process compliance verification for NPR 8705.2	P						
		Provide executive level functions for the Human-Rating Process	R	R	R	R	R		
Human Rating Independent Review Team Charter									
		Charter (Select membership and tasks) for the Human-Rating Independent Review Team	C	C	C	P	P		
		Co-Chair the Human-Rating Independent Review Team				P	P		
Human-Rating Plan Volume I									
		Develop Volume I: Human-Rating Plan						P	
30 workdays before Acquisition Strategy Meeting	60 workdays before SRR	Request ITA approve Tailoring and Exceptions						P	
15 workdays before Acquisition Strategy Meeting	45 workdays before SRR	Approve Tailoring and Exceptions		P	P				
45 workdays before SRR	45 workdays before SRR	Provide Volume I: Human-Rating Plan to the Human-Rating Independent Review Team for Preliminary Review						P	
30 workdays before SRR	30 workdays before SRR	Conduct Preliminary Review of Volume I: Human-Rating Plan and Provide Evaluation to Program							P
15 workdays before SRR	15 workdays before SRR	Provide Volume I: Human-Rating Plan to the Human-Rating Independent Review Team for Final Review						P	
Complete 5 workdays before SRR	Complete 5 workdays before SRR	Conduct Final Review of Volume I: Human-Rating Plan and Provide Evaluation to Human-Rating Board							P
Before SRR	Before SRR	Approve Volume I: Human-Rating Plan	C	P	P	P	P		
Human-Rating Plan Volume II									
		Develop Volume II: Human-Rating Plan						P	
45 workdays before PDR	45 workdays before PDR	Provide Volume II: Human-Rating Plan to the Human-Rating Independent Review Team for Preliminary Review						P	
30 workdays prior to PDR	30 workdays prior to PDR	Conduct Preliminary Review of Volume II: Human-Rating Plan and Provide Evaluation to Program							P
15 workdays before PDR	15 workdays before PDR	Provide Volume II: Human-Rating Plan to the Human-Rating Independent Review Team for Final Review						P	
5 workdays before PDR	5 workdays before PDR	Conduct Final Review of Volume II: Human-Rating Plan and Provide Evaluation to Human-Rating Board							P
Before PDR	Before PDR	Approve Volume II: Human-Rating Plan	C	P	P	P	P		
Human-Rating Plan Volume III									
		Develop Volume III: Human-Rating Plan						P	
45 workdays before CDR	45 workdays before CDR	Provide Volume III: Human-Rating Plan to the Human-Rating Independent Review Team for Preliminary Review						P	
30 workdays prior to CDR	30 workdays prior to CDR	Conduct Preliminary Review of Volume III: Human-Rating Plan and Provide Evaluation to Program							P
15 workdays before CDR	15 workdays before CDR	Provide Volume III: Human-Rating Plan to the Human-Rating Independent Review Team for Final Review						P	
5 workdays before CDR	5 workdays before CDR	Conduct Final Review of Volume III: Human-Rating Plan and Provide Evaluation to Human-Rating Board							P
Before CDR	Before CDR	Approve Volume III: Human-Rating Plan	C	P	P	P	P		
Plan Implementation									
	Upon	Implement Human-Rating Plan							

Upon Approval	Approval	Approve Waivers and Deviations to the Requirements in the Approved Human-Rating Plan		P	P					
Obtaining Human-Rating Certification										
		Request Human-Rating Certification							P	
Prior to Human-Rating Certification Decision	Prior to Human-Rating Certification Decision	Review Program Documentation and Provide Recommendation Concerning Human-Rating Certification to Human-Rating Board								P
Prior to FRR	Prior to FRR	Approve/Disapprove Human-Rating Certification	C	C	C	C	P			
Continued Certification										
Upon Certification	Upon Certification	Sustain Human-Rating Certification							P	
		Suspend Human-Rating Certification					P			
		Reinstate Human-Rating Certification	C	C	C	C	P			

1.2 Overview of the Human-Rating Certification Process

1.2.1 The objective of the human-rating certification process is to document that the critical engineering requirements, health requirements, and safety requirements have been met for a space system that provides maximum reasonable assurance that the system's failure will not result in a crew or passenger fatality or permanent disability.

1.2.2 The Program Manager is responsible for ensuring that his/her program complies with the requirements set forth in this NPR (NPR 8705.2) and that the space system is qualified for human-rating certification.

1.2.3 The Chief Safety and Mission Assurance Officer serves as the Office of Primary Responsibility for the human-rating requirements. The Human-Rating Board performs executive level activities for the Human-Rating Requirements. The Associate Administrator for Space Operations and the Associate Administrator for Exploration Systems co-chair the Human-Rating Independent Review Team. The Human-Rating Independent Review Team supports the Human-Rating Board by providing insight of the Human-Rating Plan development, implementation, and the system's human-rating certification. The Chief Engineer (Independent Technical Authority) and the Chief Health and Medical Office (Independent Technical Authority for medical and human health requirements) ensure that tailoring, exceptions, deviations, and waivers are technically correct and have adequate justification. The Associate Administrator for Space Operations, Associate Administrator for Exploration Systems, Chief Engineer, and Chief Health and Medical Officer approve the Human-Rating Plan with concurrence from the Chief Safety and Mission Assurance Officer. The Chief Safety and Mission Assurance Officer provides verification that objective quality evidence has been assessed demonstrating compliance with human-rating requirements. The Associate Administrator for Space Operations provides the human-rating certification for each space system. See Figure 2 for a summary of the human-rating certification process. See Appendix B for definition of Human-Rating Board.

1.3 General Requirements

1.3.1 The Chief Safety and Mission Assurance Officer shall serve as the Office of Primary Responsibility providing leadership, policy direction, assessment, and coordination of the technical requirements and process compliance verification for NPR 8705.2 throughout the life cycle of the system ((Requirement 34259)).

1.4 Human-Rating Independent Review Team

1.4.1 Human-Rating Independent Review Team Purpose

1.4.1.1 The Human-Rating Independent Review Team shall provide the Human-Rating Board with insight of the Human-Rating Plan development, implementation, and the system's human-rating certification process beginning in system formulation and continuing throughout the life of the program ((Requirement 34262)).

Note: In the context of human-rating requirements, the Human-Rating Independent Review Team provides insight that includes the review of the Human-Rating Plan, test plan, and verification compliance, and participation in meetings such as requirements development, requirements verification and closeout reviews, design certification reviews, and acceptance reviews.

1.4.2 Human-Rating Independent Review Team Membership

1.4.2.1 The Associate Administrator for Space Operations and the Associate Administrator for Exploration Systems shall charter (select membership and tasks of) the Human-Rating Independent Review Team that performs all functions independent of the Program Manager's funding and control ((Requirement 34265)).

1.4.2.2 The Associate Administrator for Space Operations and the Associate Administrator for Exploration Systems shall co-chair the Human-Rating Independent Review Team for each human space system ((Requirement 34266)).

1.4.3 Human-Rating Independent Review Team Membership Concurrences

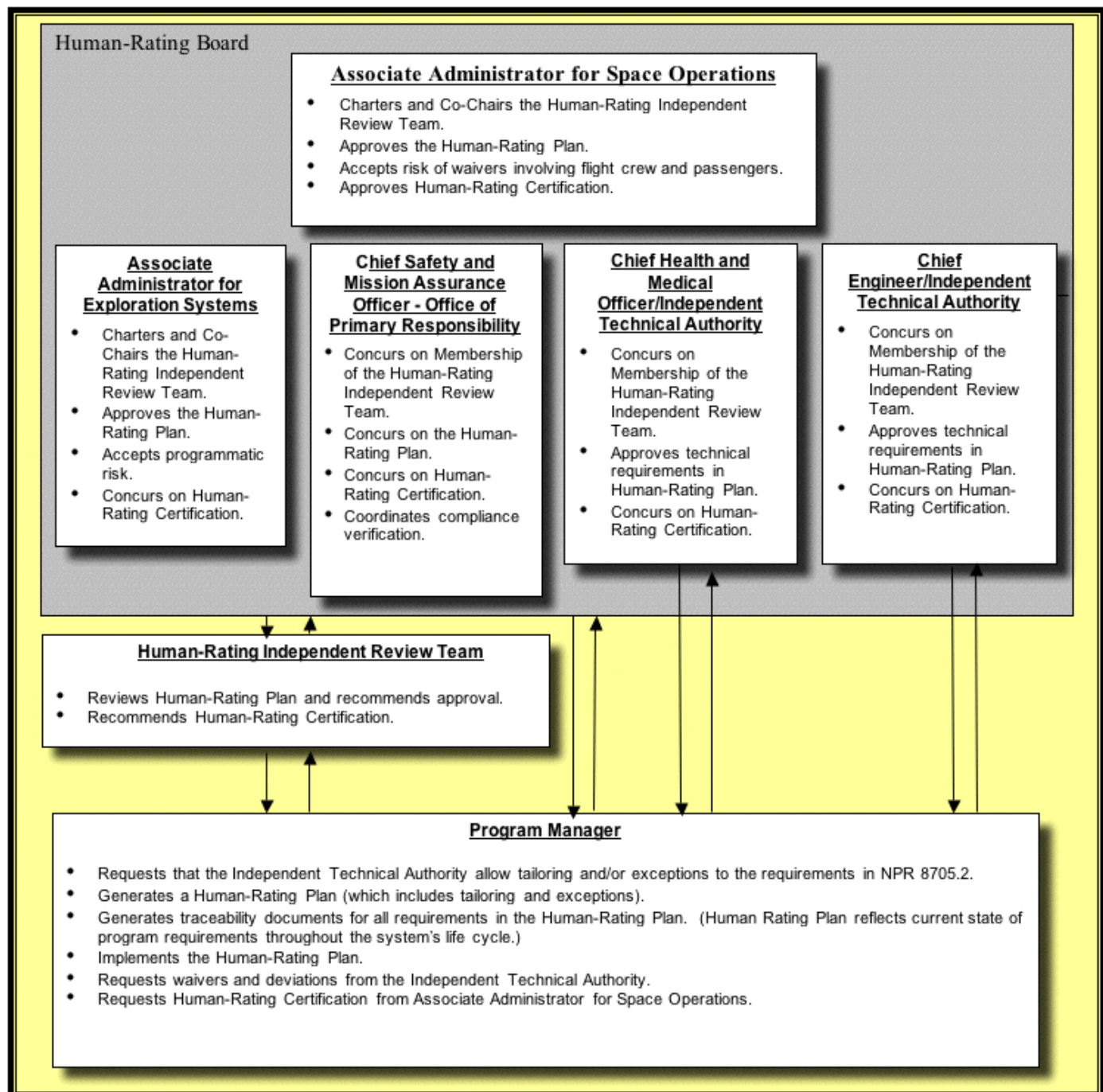
1.4.3.1 The Chief Safety and Mission Assurance Officer shall concur (or nonconcur) on the membership of the Human-Rating Independent Review Team ((Requirement 34268)).

1.4.3.2 The Chief Health and Medical Officer shall concur (or nonconcur) on the membership of the Human-Rating Independent Review Team ((Requirement 34269)).

1.4.3.3 The Chief Engineer shall concur (or nonconcur) on the membership of the Human-Rating Independent Review Team ((Requirement 34270)).

Note: The Charter is not complete until all members of the Human-Rating Board concur on the membership.

Figure 2. Human-Rating Certification Process Summary (Arrows indicate information flow)



1.5 Human-Rating Plan

1.5.1 Human-Rating Plan Development

1.5.1.1 The Program Manager shall develop a Human-Rating Plan for the human space system ((Requirement 34274).).

Note: The plan need not be a stand-alone plan provided it meets the requirements set forth in this document. One possible method is to incorporate the Human-Rating Plan into the program plan developed per NPR 7120.5.

Three volumes of the Human-Rating Plan are described within this document (NPR 8705.2). Figure 1 indicates due dates for the completion of these volumes.

1.5.2 Human-Rating Plan Content

1.5.2.1 In Volume I of the Human-Rating Plan, the Program Manager shall provide clear traceability for each requirement stated in this NPR (NPR 8705.2) by including a tracking matrix that describes how the program plans to comply with each requirement assigned to its responsibility and shows where each requirement will be incorporated into program documentation or levied onto the contractor ((Requirement 34278).).

Note: Requirements in this NPR (NPR 8705.2) that are the responsibility of other Agency professionals (e.g., Human-Rating Independent Review Team, Chief Safety and Mission Assurance Officer, and others) do not have to be included in the

Human-Rating Plan.

1.5.2.2 The Program Manager shall document in Volume I of the Human-Rating Plan all tailoring and exceptions with the corresponding justification ((Requirement 34280).).

Note: Deviations and waivers are not documented in the plan because these are generated after the plan has been approved (see Figure 3).

1.5.2.3 In Volume I of the Human-Rating Plan, the Program Manager shall include a set of applicable standards approved by the Independent Technical Authority ((Requirement 34282).).

1.5.2.4 In Volume I of the Human-Rating Plan, the Program Manager shall document the duration of the program's human-rating certification ((Requirement 34283).).

Note: The duration of the human-rating certification identifies how long the certification exists before recertification is required.

1.5.2.5 In Volume II of the Human-Rating Plan, the Program Manager shall provide a description of the objective quality evidence that will be used to demonstrate that each human-rating requirement has been met ((Requirement 34285).).

1.5.2.6 In Volume II of the Human-Rating Plan, the Program Manager shall describe the space system(s) critical functions ((Requirement 34286).).

1.5.2.7 In Volume III of the Human-Rating Plan, the Program Manager shall describe each critical function's performance criteria and how the function of each will be ensured through analysis, test, inspection, and demonstration ((Requirement 34287).).

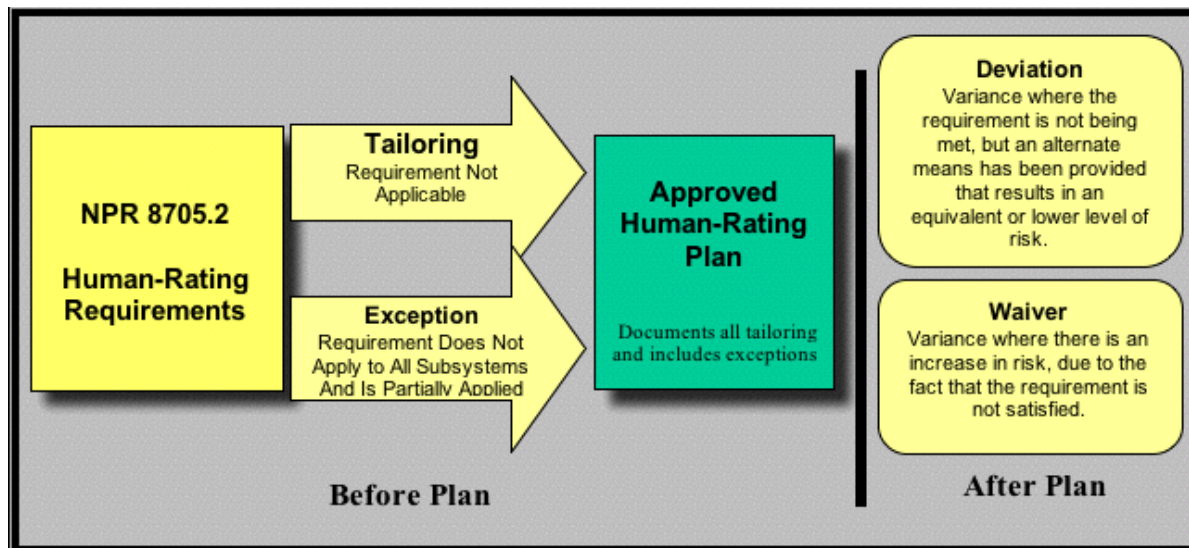
1.5.2.8 In Volume III of the Human-Rating Plan, the Program Manager shall document in the maintenance plan the processes that the program will use to ensure that the space system will be maintained in the as-certified condition ((Requirement 34288).).

Note: These processes may include (but are not limited to) raw material selection criteria and control, fabrication, inspection, tests, audits, and maintenance processes.

1.5.3 Tailoring and Exceptions to Human-Rating Requirements Documented in Plan

1.5.3.1 Introduction: Since space systems, missions, and environments vary significantly, all of the human-rating requirements and standards may not be applicable to each system. A summary of when tailoring, exceptions, waivers, and deviations occur is illustrated in Figure 3.

Figure 3: Overview of When Tailoring, Exceptions, Deviations, and Waivers Occur



1.5.4 Tailoring Process and Approvals

1.5.4.1 For a program using a phased acquisition approach, 60 workdays prior to the System Requirements Review (or for a program using the acquisition strategy meeting for down-select to a single contractor, 30 workdays prior to the acquisition strategy meeting), the Program Manager shall submit a request with supporting justification to the Independent Technical Authority to approve tailoring-out each requirement that does not apply to the space system ((Requirement 34293).).

Note: If tailoring is approved, the Program Manager does not have to meet the requirement that has been tailored out.

Note: Tailoring is for requirements that are not applicable (e.g., ascent escape requirements do not apply to a surface rover). Tailoring is not for requirements that are considered programmatically undesirable, expensive, or technically complicated.

1.5.4.2 For a program using a phased acquisition approach, 45 workdays prior to the System Requirements Review (or for a program using the acquisition strategy meeting for down-select to a single contractor, 15 workdays prior to the acquisition strategy meeting), the Independent Technical Authority shall approve (or disapprove) tailoring of the requirements in this NPR (NPR 8705.2) ((Requirement 34296).).

1.5.5 Exceptions Process and Approvals

1.5.5.1 For a program using a phased acquisition approach, 60 workdays prior to the System Requirements Review (or for a program using the acquisition strategy meeting for down-select to a single contractor, 30 workdays prior to the acquisition strategy meeting), the Program Manager shall submit a request with supporting justification to the Independent Technical Authority to approve an exception to a requirement if that requirement does not apply to all the subsystems ((Requirement 34298).).

Note: This occurs prior to System Requirements Review when the program is using a phased acquisition approach. If the program is using the acquisition strategy meeting for down-select to a single source contractor, this should be completed 30 workdays prior to the acquisition strategy meeting.

1.5.5.2 For a program using a phased acquisition approach, 45 workdays prior to the System Requirements Review (or for a program using the acquisition strategy meeting for down-select to a single contractor, 15 workdays prior to the acquisition strategy meeting), the Independent Technical Authority shall conditionally approve (or disapprove) exceptions to the requirements in this NPR (NPR 8705.2) ((Requirement 34300)).

Note: Approval is on the condition that the Associate Administrator for Exploration Systems accepts the risk posed by the exception.

1.5.6 Human-Rating Plan - Preliminary Review

1.5.6.1 Forty-five workdays prior to the specified program review, as illustrated in Figure 1, the Program Manager shall submit the specified volume of the Human-Rating Plan to the Human-Rating Independent Review Team for preliminary review ((Requirement 34303)).

1.5.6.2 Thirty workdays prior to the specified program review, as illustrated in Figure 1, the Human-Rating Independent Review Team shall provide the Program Manager with feedback concerning the adequacy of the Human-Rating Plan ((Requirement 34304)).

1.5.7 Human-Rating Plan - Final Review

1.5.7.1 Fifteen workdays prior to the specified program review, as illustrated in Figure 1, the Program Manager shall submit the specified volume of the Human-Rating Plan and supporting documentation to the Human-Rating Independent Review Team and the Human-Rating Board for final review ((Requirement 34306)).

1.5.7.2 Five workdays prior to the specified program review, the Human-Rating Independent Review Team shall provide the Human-Rating Board with an evaluation of the adequacy of the Human-Rating Plan that includes a recommendation as to whether to accept, modify, or reject the proposed Human-Rating Plan ((Requirement 34307)).

1.5.7.3 If the Human-Rating Independent Review Team recommends that the Human-Rating Plan be modified or rejected, the team shall provide the Human-Rating Board with a list of the items that must be corrected to achieve compliance ((Requirement 34308)).

1.5.8 Human-Rating Plan Approval and Concurrences

1.5.8.1 Prior to the specified program review, as illustrated in Figure 1, the Chief Engineer (Independent Technical Authority) and Chief Health and Medical Officer (Independent Technical Authority) shall approve (or disapprove) the specified volume of the Human-Rating Plan, including all tailoring and exceptions for the space system, indicating that the plan is technically acceptable ((Requirement 34310)).

1.5.8.2 Prior to the specified program review, as illustrated in Figure 1, the Associate Administrator for Space Operations and the Associate Administrator for Exploration Systems shall approve (or disapprove) the specified volume of the Human-Rating Plan ((Requirement 34311)).

1.5.8.3 Prior to the specified program review, as illustrated in Figure 1, the Chief Safety and Mission Assurance Officer shall concur (or nonconcur) on the specified volume of the Human-Rating Plan ((Requirement 34312)).

Note: If the Human-Rating Plan is not approved by the Chief Engineer, Chief Health and Medical Officer, the Associate Administrator for Space Operations, and the Associate Administrator for Exploration Systems and concurred on by the Chief Safety and Mission Assurance Officer, then the program is not authorized to implement the Human-Rating Requirements and will not be eligible for Human-Rating Certification.

1.5.8.4 At any time in the program's life, when the Independent Technical Authority approves exceptions to human-rating requirements, the Program Manager shall simultaneously have the Human-Rating Plan updated and approved ((Requirement 34314)).

1.5.9 Human-Rating Requirements Plan Compliance

1.5.9.1 Prior to certification, the Program Manager shall demonstrate compliance with the program's human-rating requirements as allocated through program documentation per the approved Human-Rating Plan ((Requirement 34316)).

1.5.10 Deviation Process and Approval

1.5.10.1 When a program's human-rating requirement will not be met, but through an alternate means, the system will have an equivalent or lower level of risk, the Program Manager shall request a deviation from the human-rating requirements ((Requirement 34318)).

1.5.10.2 The Independent Technical Authority shall approve (or disapprove) all deviations from the human-rating requirements ((Requirement 34319)).

1.5.10.3 The Associate Administrator for Exploration Systems or designee shall present the status of all new deviations at the Agency Quarterly Program Management Committee Meeting ((Requirement 34320)).

1.5.10.4 The Program Manager shall track all deviations from the human-rating requirements ((Requirement 34321)).

1.5.10.5 The Chief Safety and Mission Assurance Officer shall independently verify compliance with all deviations from the human-rating requirements ((Requirement 34322)).

1.5.11 Waiver Process and Approval

1.5.11.1 When a program does not meet a requirement in its approved Human-Rating Plan and there is an increase in risk, due to the fact that the requirement is not satisfied, and the risk and justification for the waiver have been documented, the Program Manager shall request a waiver to the requirement ((Requirement 34324)).

1.5.11.2 The Associate Administrator for Exploration Systems shall accept (or not accept) the programmatic risk for waivers

((Requirement 34325)).

1.5.11.3 The Associate Administrator for Space Operations shall accept (or not accept) the risk for waivers involving risk to flight crew and passengers ((Requirement 34326)).

1.5.11.4 Upon request for a waiver to a technical requirement, the Independent Technical Authority shall provide the program manager with technically acceptable alternatives including their corresponding risk and value assessments ((Requirement 34327)).

1.5.11.5 The Independent Technical Authority shall approve (or disapprove) waivers as technically acceptable ((Requirement 34328)). Note: Without an approval from the Independent Technical Authority stating that the waiver is technically acceptable and a statement of acceptance of the risk from the both Associate Administrator for Space Operations and the Associate Administrator for Exploration Systems, the program cannot proceed with implementation of the waiver.

1.5.11.6 The Associate Administrator for Exploration Systems or designee shall present the status of all new waivers at the Agency Quarterly Program Management Committee Meeting ((Requirement 34330)).

1.5.11.7 The Program Manager shall track the status of compliance with the provisions of all waivers ((Requirement 34331)).

1.6 Programmatic Requirements

1.6.1 Critical Functions

1.6.1.1 The Program Manager shall verify that all critical functions in the approved Human-Rating Plan have been allocated into the system design at the Critical Design Review ((Requirement 34334)).

1.6.2 Cumulative Risk Goals

1.6.2.1 Prior to System Requirements Review and throughout the development process, the Program Manager shall analyze the probability of fatality from catastrophic events and use the analysis for related design and operational trade studies ((Requirement 34336)).

1.6.2.2 When the Agency has established a relative risk goal or a relative risk requirement for a system, the Program Manager shall use probabilistic risk assessment to show compliance with the goal or requirement ((Requirement 34337)). Note: The objective of this assessment is to evaluate the cumulative mission risk for comparison with the mission risk goal. This can be accomplished by complying with NPR 8705.5, Probabilistic Risk Assessment Procedures for NASA Programs and Projects.

1.6.2.3 The Program Manager shall develop systems engineering models that are compatible with the risk model developed as part of the probabilistic risk assessment to estimate and allocate component, subsystem, and human reliability values throughout the development and operation of the system ((Requirement 34339)).

Note: Systems engineering modes can be created by using the NASA Probabilistic Risk Assessment Procedures Guide for Managers and Practitioners.

1.6.3 System Safety and Mission Assurance

1.6.3.1 The Program Manager shall implement established Agency processes (documented in NASA procedural requirements for safety and quality) relative to human health and safety that identify, analyze, track, and eliminate or mitigate hazards and risks throughout the life of the program ((Requirement 34342)).

1.6.3.2 The Program Manager shall prepare an integrated safety and mission assurance plan that maintains safety and mission assurance throughout the system life cycle and implements all of functions listed in Figure 4 ((Requirement 34343)).

Figure 4. Functions to be Included in the Integrated Safety and Mission Assurance Plan

Functions to be Included in the Integrated Safety and Mission Assurance Plan	
• Design and development controls	• Quality assurance
• Electrical, electronic and electro-mechanical (EEE) parts	• Reliability
• Emergency preparedness	• Risk management
• Fabrication controls	• Safety
• Flight test/ground operations	• Sampling plans/statistical planning and analysis
• Handling and shipping for flight hardware and software	• Software assurance
• Human error management	• Software engineering
• Identification and data retrieval	• Software formal inspection
• Maintainability	• Software independent verification and validation documentation
• Metrology	• Stamp controls
• Nonconforming articles and materials	• Systems engineering
• Probabilistic risk assessment	• Testing/inspection/evaluations
• Procurement	

1.6.3.3 The Program Manager shall ensure that the space system is designed to mitigate hazards using the following order of precedence ((Requirement 34344)).

- a. First, to eliminate hazards.

- b. Second, to reduce the likelihood of the occurrence of hazards.
- c. Third, to incorporate safety devices.
- d. Fourth, to provide caution and warning devices.
- e. Fifth, to develop administrative procedures and training.

1.6.4 Human Factors Engineering

1.6.4.1 The Program Manager shall apply human factors engineering beginning in early concept development and continuing throughout the life cycle of the space system ((Requirement 34346)).

1.6.4.2 The Program Manager shall involve human factors engineering and users, such as the Astronaut Office, mission operations personnel, and ground support personnel, in the development of human system interfaces ((Requirement 34347)).

1.6.4.3 The Program Manager shall establish human performance criteria and system usability requirements to ensure crew and passenger safety ((Requirement 34348)).

1.6.5 General Testing and Verification

1.6.5.1 The Program Manager shall perform demonstration, test, and analyses of critical functions at the integrated system level to ensure that the system design will not cause loss of life or permanent disability ((Requirement 34350)).

Note: Testing is used to verify the integrated performance of the space system hardware and software in the operational configuration. It is acceptable for the program to test elements in logical groupings with appropriate fidelity emulations of interfaces. It is preferred that integrated testing be performed on actual hardware rather than simulated or emulated interfaces.

1.6.6 Human-In-The-Loop Testing

1.6.6.1 The Program Manager shall perform usability testing of human-system interfaces for the critical functions using support from the user community including the Astronaut Office, ground processing crew, and mission control crew to verify that the system design meets the human performance requirements during system operation and in-flight maintenance consistent with the anticipated mission operations concept and anticipated mission duration ((Requirement 34353)).

1.6.6.2 The Program Manager shall use an iterative design process, where the results of the usability testing are incorporated into the design ((Requirement 34354)).

1.6.7 Software Testing

1.6.7.1 The Program Manager shall perform testing to verify and validate the performance, security, and reliability of all critical software across the entire performance envelope (or flight envelope) including mission functions, modes, and transitions ((Requirement 34356)).

1.6.7.2 Flight software shall, at a minimum, be tested using a flight-equivalent avionics test-bed operating in a real-time, closed-loop test environment ((Requirement 34357)).

1.6.7.3 The Program Manager shall test ground-control software on the computer platforms that will be used to support flights (space missions) ((Requirement 34358)).

1.6.8 Flight Testing

1.6.8.1 In Volume III of the Human-Rating Plan, the Program Manager shall document the type and number of flight tests that will be performed across the mission profile under actual and simulated conditions to achieve human-rating certification ((Requirement 34360)).

Notes

- i. The type and number of flight tests will be approved as part of the Human-Rating Plan approval process.
- ii. The flight test program provides two objectives. First, the flight test program uses testing to validate the integrated performance of the space system hardware and software in the operational flight environment. Second, the flight test program uses testing to validate the analytical math models that are the foundation of all other analyses, including those used to define operating boundaries not expected to be approached during normal flight.
- iii. Flight and ground tests are needed to ensure that the data for the analytical models can be interpolated to confidently predict the performance of the space systems at the edges of the operational envelopes and to predict the margins of the critical design parameters.
- iv. In order to minimize risk to the flight test crew, it is preferred that an unmanned flight test be conducted prior to a manned flight test. It is acknowledged that this may not be feasible for all phases of flight and may not be necessary at all for some systems (e.g., rovers).

1.7 Human-Rating Certification

Note: Human-rating certification is the documented authorization granted by the Associate Administrator for Space Operations that validates that the system will perform its mission in the expected environment and verifies with objective quality evidence that the requirements were met allowing the Program Manager to operate the space system within its prescribed parameters for its defined reference missions. Human-Rating Certification is obtained prior to the first crewed flight (for flight vehicles) or operational use (for other systems).

Note: The human-rating certification process is accomplished prior to a program's flight readiness review process, and the human-rating certification is presented at the flight readiness review.

1.7.1 Human-Rating Certification Request

1.7.1.1 The Program Manager shall submit a request to the Associate Administrator for Space Operations for human-rating

certification for a space system ((Requirement 34366)).

Note: This applies to both initial certification and recertification after the approved certification period has ended.

1.7.1.2 At the time that the Program Manager submits a request for human-rating certification, the Program Manager shall provide the Associate Administrator for Space Operations, Chief Safety and Mission Assurance Officer, Associate Administrator for Exploration Systems, Chief Health and Medical Officer, Chief Engineer, and the Human-Rating Independent Review Team with a submission package that includes the following documents: the verification matrix that tracks status of each requirement in the approved Human-Rating Plan, the objective quality evidence that coincides with the matrix and demonstrates compliance with the requirements, the design reference missions, the system specification, and the documentation for all deviations and waivers ((Requirement 34368)).

Note: This data may be provided in hard copy, electronically, or via the web.

1.7.1.3 As a part of the human-rating certification process, the Program Manager shall demonstrate that appropriate process controls are in place for maintaining critical aspects of the human-rating certification throughout the life cycle of the program, including but not limited to ((Requirement 34370)).

- a. Production, procurement, and traceability of materials and components ((Requirement 34371)).
- b. Fabrication, maintenance, and inspection quality ((Requirement 34372)).
- c. System configuration control (Requirement 34373).
- d. Sustaining engineering (Requirement 34374).
- e. Maintenance and control of certification documentation ((Requirement 34375)).

1.7.2 Human-Rating Certification Recommendation

1.7.2.1 The Human-Rating Independent Review Team shall evaluate the adequacy of the program's compliance with the human-rating requirements as documented in the approved Human-Rating Plan and recommend whether the system should be certified as human-rated ((Requirement 34377)).

1.7.3 Human-Rating Certification

1.7.3.1 Prior to the flight readiness review, the Associate Administrator for Space Operations shall certify (or not certify) each space system as human-rated (Requirement 34379).

Note: If one of the Human-Rating Board members listed in 1.7.4 does not concur with the certification, the system cannot receive a human-rating certification.

1.7.4 Human-Rating Certification Concurrences

1.7.4.1 The Chief Safety and Mission Assurance Officer shall concur (or nonconcur) on the human-rating certification of any space system to be crewed during any phase of flight (Requirement 34382).

1.7.4.2 The Chief Health and Medical Officer shall concur (or nonconcur) on the human-rating certification of any space system to be crewed during any phase of flight (Requirement 34383).

1.7.4.3 The Chief Engineer shall concur (or nonconcur) on the human-rating certification of any space system to be crewed during any phase of flight (Requirement 34384).

1.7.4.4 The Associate Administrator for Exploration Systems shall concur (or nonconcur) on the human-rating certification of any space system to be crewed during any phase of flight (Requirement 34385).

1.7.5 Sustaining Human-Rating Certification

1.7.5.1 To sustain certification, the Program Manager shall provide sustaining and preventative maintenance to the space system to ensure it stays in the "as-certified condition" (Requirement 34387).

Note: This requirement exists because if the program manager stopped performing sustaining and preventative maintenance to the certified space system, its condition could degrade until it no longer had adequate safety and reliability.

1.7.5.2 The Program Manager shall implement a process that sustains the human-rating certification throughout the system's life cycle (Requirement 34389).

1.7.5.3 The Program Manager shall maintain the integrated safety and mission assurance plan throughout the system life cycle (Requirement 34390).

1.7.5.4 The Program Manager shall update analytical models throughout the life of the program by including design changes and actual operational and flight performance data (Requirement 34391).

1.7.5.5 The Program Manager shall maintain the risk assessment model throughout the system life cycle (Requirement 34392).

1.7.5.6 The Program Manager shall maintain the systems engineering model throughout the system life cycle (Requirement 34393).

1.7.5.7 The Program Manager shall keep all documentation related to the human-rating certification up-to-date throughout the system life cycle, including, but not limited to: the Human-Rating Plan, deviations, waivers, risk acceptance rationale, system drawings, compliance verification documentation, system maintenance plan, and safety and mission assurance plan (Requirement 34394).

1.7.6 Suspension of Human-Rating Certification

1.7.6.1 The Program Manager shall obtain Associate Administrator for Space Operations concurrence for any design changes or proposed alterations of equipment that affect the human-rating certification of the space system (Requirement 34396).

1.7.6.2 If the space system undergoes modifications or any changes to mission or environment that impact the human-rating certification as determined by the Associate Administrator for Space Operations, the Program Manager shall submit for approval

the Human-Rating Plan with identified changes, any risk mitigations taken, and any increases to system risk (Requirement 34397).

1.7.6.3 If, during independent assessments and/or audits or after failures, deficiencies are identified in the "as-certified" design, operation, and/or maintenance of the space system, the Associate Administrator for Space Operations shall suspend the space system human-rating certification, thereby prohibiting use of the system for crews and passengers until compliance is reached and/or prohibition has been resolved (Requirement 34398).

1.7.7 Human-Rating Certification Reinstatement

1.7.7.1 The Associate Administrator for Space Operations shall reinstate human-rating certification only after the cause of the suspension has been thoroughly investigated and satisfactorily corrected and after he/she has obtained concurrences from the other Human-Rating Board members (Requirement 34400).

1.7.7.2 The Chief Safety and Mission Assurance Officer shall concur (or nonconcur) on the reinstatement of the human-rating certification (Requirement 34401).

1.7.7.3 The Chief Health and Medical Officer shall concur (or nonconcur) on the reinstatement of the human-rating certification (Requirement 34402).

1.7.7.4 The Chief Engineer shall concur (or nonconcur) on the reinstatement of the human-rating certification (Requirement 34403).

1.7.7.5 The Associate Administrator for Exploration Systems shall concur (or nonconcur) on the reinstatement of the human-rating certification (Requirement 34404).

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